**It ain't heavy...**

Engineers' craft a new device to lighten human loads

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**Desert be-in**

Answers to your burning questions about that zany Nevada gathering

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**New faculty**

Portraits of five fresh brains from the academic class of 2003-04

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# Berkeleyan

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## UC President visits the system's 'mother lode'

### A busy couple of days for Robert Dynes on his swing through Berkeley

By Bonnie Azab Powell
PUBLIC AFFAIRS

"This is like a vacation," UC President Robert Dynes told a lab-ful of Berkeley scientists and engineers after they'd made presentations to him based on the university's top research efforts. "You have no idea how fun this is for me." His energy seemed genuine, remarkable in light of the fact that he was only two-thirds of the way through a grueling two-day immersion in all things Berkeley.

Cabinet members brought up some of their immediate challenges, including how to retain faculty in an arid budget climate, with salaries becoming less competitive; the effect of the Bay Area's high cost of construction on the looming docket of retrofits and modernization efforts needed to upgrade Berkeley's aging campus; and how to foster a better public understanding of the UC admission process.

Dynes then met with student leaders from the ASUC, the Rally Committee, Boalt Hall School of

**Botanical booster**

# Berkeley grad students to receive Fulbright funding

UC Berkeley and FedEx Corp. have agreed to fund jointly special Fulbright research abroad fellowships for advanced graduate students, resolving a controversy that erupted last month when the U.S. Department of Education declared the application deadline had been missed.

FedEx will contribute approximately half the anticipated financial need for the fellowships. Chancellor Robert Berdahl stated that the balance of the funding will come from the campus's fellowship endowment.

Through a collaborative effort between FedEx, Berkeley, and Gov. Arnold Schwarzenegger, a solution was found to assist with the funding of the Fulbright awards following a special review of the Berkeley applications put in place by the Fulbright Scholarship Board.

"The care and concern for these students shown by FedEx and Gov. Schwarzenegger is tremendously impressive," said Berdahl.

The U.S. Department of State's Bureau of Educational and Cultural Affairs is managing a special review of applications from Berkeley graduate students. The review will adhere to the rigorous Fulbright guidelines, thereby providing recipients a fellowship that will carry the Fulbright name and prestige.

The Fulbright board recommended the separate review of the Berkeley applicants, but required that funding for any fellowships awarded not come from Fulbright funds. FedEx and campus officials agreed on this solution, which places the students' interest first and foremost at this critical time in their careers.

The announcement concludes a story that began in January when the Department of Education ruled that when the Berkeley applications were not picked up on time, the application deadline was technically missed and that there would be no recourse for the students.

Last year, 30 Berkeley graduate students applied for Fulbright grants, and half the students were awarded fellowships. Again this year, 30 students from a number of fields were applying for fellowships for the 2004-05 school year.

# Campus researchers developing robotic exoskeleton that can enhance human strength and endurance

By Sarah Yang
PUBLIC AFFAIRS

The mere thought of hauling a 70-pound pack across miles of rugged terrain or up 50 flights of stairs is enough to evoke a grimace in even the burliest individuals. But breakthrough robotics research at Berkeley could soon bring welcome relief — in the form of a self-powered "exoskeleton" that would effectively take the load off people's backs.

"We set out to create an exoskeleton that combines a human control system with robotic muscle," says Homayoon Kazerooni, professor of mechanical engineering and director of the campus Robotics and Human Engineering Laboratory. "We've designed this system to be ergonomic, put out a highrise blaze, or by rescue workers bringing in food and first-aid supplies to areas where vehicles cannot enter.

"The fundamental technology developed here can also be developed to help people with limited muscle ability to walk optimally," says Kazerooni.

The researchers point out that the human pilot does not need a joystick, button, or special keyboard to "drive" the device. Rather, the machine is designed so that the pilot, who requires no special training to operate it, becomes an integral part of the exoskeleton. In the Berkeley experiments, the human pilot moved about a room wearing the 100-pound exoskeleton and a 70-pound backpack while feeling as if he were lugdo to distribute the weight so little to no load is imposed on the wearer.

The engineers point out that while the exoskeleton does the heavy lifting, the human contributes to the balance. "The pilot is not 'driving' the exoskeleton," says Kazerooni. "Instead, the control algorithms in the computer are constantly calculating how to move the exoskeleton so that it moves in concert with the human."

"We are taking great pains to make this as practical and robust as possible for the wearer," says Kazerooni. "Several engineers around the world are working on motorized exoskeletons that can enhance human strength, but we've advanced our design to the point where a 'pilot' could strap on the external metal frame and walk in figure eights

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The mere thought of hauling a 70-pound pack across miles of rugged terrain or up 50 flights of stairs is enough to evoke a grimace in even the burliest individuals. But breakthrough robotics research at Berkeley could soon bring welcome relief — in the form of a self-powered "exoskeleton" that would effectively take the load off people's backs.

"We set out to create an exoskeleton that combines a human control system with robotic muscle," says Homayoon Kazerooni, professor of mechanical engineering and director of the campus Robotics and Human Engineering Laboratory. "We've designed this system to be ergonomic, highly maneuverable, and technically robust, so the wearer can walk, squat, bend, and swing from side to side without noticeable reductions in agility. The human pilot can also step over and under obstructions while carrying equipment and supplies."

The Berkeley Lower Extremity Exoskeleton (BLEEX), as it's officially called, consists of mechanical metal leg braces that are connected rigidly to the user at the feet and, in order to prevent abrasion, more compliantly elsewhere. The device includes a power unit and a backpack-like frame used to carry a large load.

Such a machine could become an invaluable tool for anyone who needs to travel long distances by foot with a heavy load. The exoskeleton could eventually be used by army medics carrying injured soldiers off a battlefield, by firefighters hauling their gear up dozens of flights of stairs to put out a highrise blaze, or by rescue workers bringing in food and first-aid supplies to areas where vehicles cannot enter.

"The fundamental technology developed here can also be developed to help people with limited muscle ability to walk optimally," says Kazerooni.

The researchers point out that the human pilot does not need a joystick, button, or special keyboard to "drive" the device. Rather, the machine is designed so that the pilot, who requires no special training to operate it, becomes an integral part of the exoskeleton. In the Berkeley experiments, the human pilot moved about a room wearing the 100-pound exoskeleton and a 70-pound backpack while feeling as if he were lugging a mere 5 pounds.

The user steps into a pair of modified Army boots that are then attached to the exoskeleton. A pair of metal legs frames the outside of a person's legs to facilitate ease of movement. The wearer then dons the exoskeleton's vest, which is attached to the backpack frame and engine. If the machine runs out of fuel, the exoskeleton legs can be easily removed so that the device converts to a large backpack.

More than 40 sensors and hydraulic actuators form a local area network (LAN) for the exoskeleton, functioning much like a human nervous system. The sensors, including some embedded within the shoe pads, are constantly providing information to the central computer brain so it can adjust the load based upon what the human is doing. When it is turned on, the exoskeleton is constantly calculating what it needs to do to distribute the weight so little to no load is imposed on the wearer.

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"We are taking great pains to make this as practical and robust as possible for the wearer," says Kazerooni. "Several engineers around the world are working on motorized exoskeletons that can enhance human strength, but we've advanced our design to the point where a 'pilot' could strap on the external metal frame and walk in figure eights around a room. No one else has done that."

Appropriately, the first step in the project (funded by the Defense Advanced Research Projects Agency) began with researchers analyzing the human step. They gathered information about how people walk and move — including the propulsive force and torque needed from the ankles and the shock absorbing power of the knees — so they could adapt the exoskeleton to a wide range of natural human movements.

"Many scientists and engineers have been attempting to build a robotic strength-enhancing device since the 1950s, and they've failed," says Kazerooni. "It is only through recent engineering breakthroughs that this dream is now becoming a reality."

For information on the Berkeley Human Engineering Laboratory, go to **www.me.berkeley.edu/hel**.

UC Berkeley photo

Attached rigidly at the feet and more compliantly elsewhere, the Berkeley Lower Extremity Exoskeleton (BLEEX) could lighten the load borne by soldiers, firefighters, rescue workers — anyone who must carry heavy loads over long distances.


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